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Global prevalence of percutaneous injuries among health-care workers: a systematic review and meta-analysis

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Abstract

Background: Health-care workers (HCWs) are at risk of occupational exposure to blood-borne pathogens through contact with human blood and other body fluids. This study was conducted to estimate the global and regional one-year prevalence of percutaneous injuries (PCIs) among HCWs.

Methods: We systematically searched EMBASE, PubMed, CINAHL and PsychInfo databases for studies published from January 2008 to January 2018 that reported the prevalence of PCIs among HCWs. A random effects meta-analysis was conducted to estimate pooled prevalence of PCIs among HCWs.

Results: Of the 5205 articles identified, 148 studies from 43 countries met the inclusion criteria. The pooled global one-year prevalence estimate of PCIs was 36.4% (95% CI: 32.9 – 40.0). There were substantial regional variations in the one-year prevalence of PCIs, ranging from 7.7% (95% CI: 3.1 – 12.4) in South America to 43.2% (95% CI: 38.3 – 48.0) in Asia. The estimates for Africa and Europe were comparable with values of 34.5% (95% CI: 29.9 – 39.1) and 31.8% (95% CI: 25.0 – 38.5), respectively. The highest one-year prevalence by job category was among surgeons at 72.6% (95% CI: 58.0 – 87.2). The estimates for medical doctors (excluding surgeons), nurses (including midwives) and laboratory staff (including laboratory technicians) were 44.5% (95% CI: 37.5 – 51.5), 40.9% (95% CI: 35.2 – 46.7) and 32.4% (95% CI: 20.9 – 49.3), respectively. PCIs commonly occurred among HCWs working in hospital (41.8%, 95% CI: 37.6 – 46.0) than non-hospital (7.5%, 95% CI: 5.9 – 9.1) settings.

Conclusion: Our findings suggest high rates of PCIs among HCWs with direct patient care across many regions of the world. However, paucity of data from some countries was a major limitation.

Keywords: Percutaneous injuries, needlestick injuries, sharps, occupational exposure, blood and other body fluids, healthcare workers

Key messages

- We found high prevalence of PCIs among HCWs worldwide with about one in three HCWs at risk of injury annually.
- The risk of PCIs was associated with job category, years of work experience, training status and institutional setting of HCWs.
- The high prevalence found in this review has a great implication in terms of the risk of transmitting blood-borne viruses to HCWs.
- The evidence from this review highlight the need for HCWs to adhere to standard precautions when handling sharps and for national governments and employers to provide a safe working environment and establish policies that would minimise the risk of PCIs in healthcare settings.

Introduction

Occupational exposure to blood-borne pathogens following contact with human blood and body fluids continues to be a serious concern for health-care workers (HCWs) globally. Although many of these pathogens have been identified, hepatitis B virus (HBV), hepatitis C virus (HCV) and human immunodeficiency virus (HIV) are the three leading causes of occupationally-related blood-borne infections among HCWs.[1, 2] Occupational exposure to these viruses can occur following percutaneous injury (when a needle or other sharp object penetrates the skin), mucous membrane (such as eyes, nose and mouth) or non-intact skin exposure to blood and body fluids. Percutaneous injuries (PCIs), however, carry a greater risk of infection as they account for 66%–95% of all occupational exposures to blood-borne pathogens.[3] Every year, PCIs result in approximately 66,000 HBV infections, 16,000 HCV infections and 1,000 HIV infections.[3] These infections can cause about 1,100 deaths and significant disability annually.[3] More than 90% of these infections occur in developing countries where, in particular, adherence to standard precautions is poor.[4]

Little is known about the global prevalence and incidence of percutaneous injury among HCWs. Prüss-Üstün et al.,[3] estimated that more than three million HCWs worldwide have occupationally-related PCIs annually. However, this study was conducted over a decade ago, necessitating an updated analysis. Many developed countries including the United States, United Kingdom and Canada have established surveillance systems to monitor the occurrence of PCIs among HCWs and to understand the circumstances under which they occur.[5] Despite this, the underreporting and poor documentation of PCIs by HCWs have rendered these surveillance systems ineffective in determining the true incidence of PCIs in these countries.

Over the past decade, several studies on the prevalence of PCIs among HCWs in different settings have been published. Nevertheless, no systematic review has been conducted to provide a pooled global estimate of the prevalence of PCIs among HCWs. Previous global systematic reviews have focussed on identifying the interventions to minimise PCIs among HCWs and in evaluating the cost associated with PCIs.[6, 7] However, understanding the extent and circumstances under which PCIs occur among HCWs is an important initial step in prevention. Therefore, we conducted a systematic review and meta-analysis to estimate the global and regional one-year prevalence of percutaneous injuries among HCWs, and identify demographic groups at risk.

Methods

Protocol registration and search strategy

The research protocol was registered in the PROSPERO international prospective register of systematic reviews (CRD42017077201). We searched four databases (PubMed, EMBASE, CINAHL and PsychInfo) on February 1, 2018, to identify studies reporting the one-year prevalence of PCIs among HCWs globally. These databases were searched for original research articles published from January 1, 2008, to January 31, 2018. We considered this timeframe sufficient to capture a wide range of relevant papers that reflect the current picture of PCIs among HCWs. The following terms were combined using Boolean operators in our literature search; occupational exposure, accidental exposure, percutaneous injuries, needlestick injuries, sharps, blood, body fluid, blood-borne pathogens, health care workers, health workers and health personnel (Supplementary Table 1). Additional articles including grey literature were identified by checking the reference lists, Google and Google Scholar search. No language restrictions were applied to all the searches conducted.

Eligibility criteria

Two reviewers independently screened studies against the inclusion and exclusion criteria. Papers were included if they contain data on the one-year (or 12-month) prevalence of PCIs among HCWs. In this review, we considered HCWs to include all paid and unpaid individuals working in healthcare settings who are likely to be exposed to infectious materials including blood and other body fluids. Hence, we included studies that enrolled a variety of participants including doctors, nurses, laboratory technicians, auxiliary health care workers and students undertaking clinical training or experience in healthcare settings.

Studies reporting lifetime and other forms of period prevalence (such as 3 or 6-month prevalence) were excluded. Other inclusion and exclusion criteria relate to the design of the study. Observational studies that used either cohort or cross-sectional designs were included. Case reports, case series, case-control studies and qualitative studies were excluded. Studies involving a review of reported cases or surveillance data were excluded as under-reporting of exposure to PCIs has been well documented.[8] In addition, reviews, conference abstracts, letters, commentaries, personal opinions and studies that utilised fewer than 100 participants were also excluded.

Quality assessment of included studies

All included studies were assessed for quality on nine (9) criteria based on the Joanna Briggs Institute's critical appraisal framework for prevalence studies.[9] These nine criteria assessed the internal and external validity of each included study with each criterion equally weighted

(see Supplementary Table 2). Based on the assessment, each article received a quality grade of low, moderate or high if they met 1-3, 4-6 and 7-9 criteria, respectively.

Data extraction

Two reviewers extracted data and any discrepancy was resolved by consensus. The following data: author, year of publication, country of study, United Nations geographical region, World Bank country income classification (low, middle or high-income country), type of institution (hospital or non-hospital including primary care and pre-hospital services), sample size, response rate and prevalence of PCIs were extracted from each included article and entered into a Microsoft Excel spreadsheet (version 2016). Other data extracted were the prevalence of PCIs by health staff category and the proportion of cases that were due to needle stick injuries.

Data analysis

Statistical analyses were performed using Stata version 14.2 (StataCorp. LLC, College Station, United States of America). A random effects meta-analysis based on the DerSimonian and Laird approach,[10] was conducted to determine pooled one-year prevalence estimates (with 95% confidence intervals) of PCIs among HCWs. Sensitivity analyses were carried out by excluding low quality studies and the impact of excluding them was evaluated on the summary results. This was done to test the robustness of our findings. Generally, one-year prevalence was estimated from studies that reported the proportion of study participants who had at least one percutaneous injury in the 12 months preceding the study.

Interstudy heterogeneity was assessed with Cochran's Q (reported with a χ^2-value and p-value) and Higgin's I-squared (I^2) statistic was employed to measure the percentage of total variation across studies that was due to heterogeneity.[11] Sub-group and meta-regression analyses were conducted to explore the causes of heterogeneity. The co-variates considered included the United Nations geographical region, World Bank country classification by income level, type of institution, study period, sampling procedure (random vs convenience sampling), sample size and study quality. Covariates were first tested individually and only those with p-values < 0.10 were included in the multivariable model.

Stratified analyses were conducted to determine the pooled prevalence of PCIs among different categories of HCWs. In addition, individual data for relative risk were pooled together using a random effects model to present the relative risk of PCIs between groups.

Results

Study selection and characteristics

Our literature search identified 5205 records but only 148 articles met the inclusion criteria (Figure 1). The 148 articles were cross-sectional observational studies and covered 109267 HCWs from 43 countries. Most of the included studies were conducted in Asia (n = 77) and Africa (n = 36), followed by Europe (n = 18) and North America (n = 12) (Supplementary Table 3). The methodological quality of 15 (10.1%) of the included studies were considered high, 127 (85.8%) moderate and 6 (4.1%) low.

Prevalence of PCIs

The pooled global one-year prevalence estimate of PCIs was 36.4% (95% CI: 32.9 – 40.0). These injuries were largely due to needle sticks with an estimated one-year prevalence of 35.1% (95% CI: 31.4 – 38.8). The pooled one-year prevalence of PCIs obtained following the exclusion of low quality studies from the analysis was 36.1% (95% CI: 32.5 – 39.7), which is similar to the global pooled estimate.

There were substantial variations in the one-year prevalence of PCIs across the world's continents, ranging from 7.7% (95% CI: 3.1 – 12.4) in South America to 43.2% (95% CI: 38.3 – 48.0) in Asia (Table 1 and Supplementary Figure 1). Substantial variations were also observed within sub-continents (Table 1 and Supplementary Figure 2). Estimated one-year prevalence of PCIs among HCWs were highest in North Africa, East Asia, Eastern Europe and the Middle East with values of 49.7% (95% CI: 33.8 – 65.6), 47.2% (95% CI: 37.8 – 56.6), 47.3% (95% CI: 27.4 – 67.1) and 43.8% (95% CI: 35.5 – 52.1), respectively.

Furthermore, we observed a substantial variation in the country level estimates of the one-year prevalence of PCIs (Figure 2). PCIs were commonly reported by HCW in Jordan, Syria and Afghanistan with the estimated one-year prevalence of 76.9% (95% CI: 57.4 – 96.4), 76.6% (95% CI: 72.0 – 81.2) and 72.6 (69.2 – 76.0), respectively. Countries with lower one-year prevalence of PCIs were Singapore, Hong Kong, Brazil and New Zealand with estimated values of 3.5% (95% CI: 1.1 – 5.9), 5.9% (95% CI: 4.3 – 7.5), 7.7% (95% CI: 3.1 – 12.4) and 9.1% (95% CI: 7.6 – 10.6), respectively. Country specific one-year prevalence estimates and number of participants are shown in Supplementary Table 4.

Prevalence of PCIs by job and sociodemographic categories

The highest one-year prevalence by job category was among surgeons with an estimated value of 72.6% (95% CI: 58.0 – 87.2). The estimated pooled one-year prevalence for medical doctors (excluding surgeons), nurses (including midwives) and laboratory staff (including laboratory technicians) were 44.5% (95% CI: 37.5 – 51.5), 40.9% (95% CI: 35.2 – 46.7) and

32.4% (95% CI: 20.9 – 49.3), respectively (Table 2). There was no difference in the risk of PCIs between doctors and nursing staff (RR of doctors vs nursing staff: 1.082, 95% CI: 0.955 – 1.225). However, the risk of PCIs among doctors and nurses were higher than those of laboratory staff (RR doctors vs laboratory staff: 1.478, 95% CI: 1.128 – 1.936; nurses vs laboratory staff: 1.584, 95% CI: 1.253 – 2.002). Six studies presented data on the prevalence of PCIs among paramedics or emergency medical services personnel, with the pooled one-year prevalence estimate of 10.5% (95% CI: 6.9 – 14.1). Similarly, fourteen studies reported on the one-year prevalence of PCIs among clinical nursing and medical students with a pooled estimate of 38.9% (95% CI: 26.3 – 51.5).

We found a higher risk of PCIs among HCWs with ≤ 5years of work experience when compared to those with > 5 years (RR =1.365, 95%CI: 1.163 – 1.603). There was no difference in the risk of PCIs between female and male HCWs (RR=1.087, 95% CI: 0.982 - 1.205). Six studies reported on the proportion of HCWs who had received training on issues related to infection prevention and occupational risk reduction that were occupationally exposed to PCIs. The pooled relative risk of the data from these studies showed that HCWs without training were more likely to be occupationally exposed to PCIs than trained staff (RR=1.459, 95% CI: 1.094 - 1.946).

Table 3 presents the one-year prevalence of PCIs by health settings. PCIs were more common among hospital staff, with a prevalence of 41.8% (95% CI: 37.6 – 46.0). The one-year prevalence of PCIs among HCWs working in non-hospital settings including primary care and pre-hospital emergency services was 7.5% (95% CI: 5.9 – 9.1). Nine studies reported the one-year prevalence of PCIs in primary care settings. The estimated pooled prevalence was 5.9% (4.2 – 7.7).

The subgroup meta-analysis showed that high income countries had lower one-year prevalence of PCIs among HCWs, with a pooled estimate of 24.8% (95% CI: 19.4 – 30.2). The overall estimates for low and middle-income countries were 36.3% (95% CI: 30.3 – 42.2) and 41.8% (95% CI: 36.7 – 46.9), respectively (Supplementary Table 5). Finally, substantial heterogeneity was observed on the pooled estimate of the global one-year prevalence of PCIs among HCWs ($\mathcal{X}^2$ = 40855.1, p < 0.001, I^2= 99.6%). Of the sources of variation investigated through meta-regression, only geographical region, World Bank income classification level and institution type had p values < 0.10. These covariates yielded a multivariate model (p < 0.001) that explained 29.3% of between-study variation.

Discussion

This is the first systematic review to provide a comprehensive global overview of the one-year prevalence of PCIs among HCWs. We found a high prevalence of PCIs among HCWs worldwide. Needlestick injuries account for most of the PCIs, with about one in three HCWs at risk of injury annually. This high prevalence has great implications in terms of the exposed HCWs' mental health and the risk of acquiring blood-borne infections. Psychological problems including depression, anxiety, post-traumatic stress disorder and job burnout have been linked to occupational exposure to blood and other body fluids among HCWs.[12-14] Furthermore, PCIs come with a significant financial cost to the health system. This cost could be associated with managing the affected HCWs or payment for compensation claims. A recent review estimated the average direct and in-direct cost of managing a needlestick injury to be US$747.[6]

We also identified regional variations in the one-year prevalence of PCIs with higher figures in East Asia, Middle East, North Africa and Eastern Europe. The result for North Africa compares well with the findings of a previous analysis of HCWs' occupational exposure to body fluids in 21 countries in Africa.[8] South America had the lowest regional prevalence in our review. This may be because all the studies included in this region were conducted in primary care settings with potentially reduced clinical activities. With the exception of the explanation offered for the low estimate in South America, the reason for the regional variations observed in this review is not entirely clear. It is likely that PCIs were under-reported in some studies, which may have contributed to the observed regional differences even within the same continent. Nonetheless, the observed variations may be a reflection of the differences in national legislation and implementation of measures (including use of safety-engineered devices, education and training) to prevent injuries by sharps. For example, in the US where there is a legislative mandate for the use of safety-engineered devices and the adoption of the legislation is high,[15] we observed a low prevalence of PCIs among HCWs. On the other hand, prevalence of PCIs was high in many developing economies including Jordan, Syria and Afghanistan where preventive measures such as the use of safety-engineered devices are lacking.

Many factors are known to influence the risk of transmission of HIV and HBV following PCIs including the volume of blood exposed to, viral load of the source patient, HBV vaccination status and HIV post-exposure prophylaxis (PEP) uptake.[16] It was worrying to observe that sharps injuries were commonly reported in countries where the prevalence of HIV and HBV are high and HBV vaccination coverage and HIV PEP uptake among HCWs are low.[17, 18] The high prevalence of these infections coupled with the low uptake of HBV vaccination and HIV PEP could predispose many HCWs to these infections.

Our analysis by job category reveals that surgeons had the highest prevalence of PCIs. Similarly, PCIs were more common among doctors (surgeons excluded), dentists and nurses than laboratory staff or paramedics. This is unsurprising given that these healthcare professionals' roles require a greater level of sharps exposure than others. Contrary to our finding, when rates of PCIs per 100 full-time equivalents were investigated through prospective observation or surveillance; nurses were the job category more frequently at risk.[19, 20] Nurses were also more likely to acquire an occupational infection than other professional groups (including surgeons) because procedures with hollow-bore, blood-filled needles that carry greater risk of transmission of occupational infection are commonly performed by them.[20] We also found that PCIs were more common among HCWs working in hospitals than those in non-hospital settings. Although, procedures such as phlebotomy and vaccination are frequently performed in non-hospital settings, situations requiring a higher frequency of invasive procedures are more likely to be carried out in hospitals, probably accounting for the observed difference.

Our systematic review did not include surveillance data because of under-reporting of cases of injury by HCWs. Surveillance data tend to underestimate the prevalence of PCIs as we found higher PCIs rates than those reported in individual studies utilising surveillance data.[21, 22] This implies that PCIs are likely to be much more common than we think. While surveillance data are important in understanding the circumstances under which PCIs occur, the current system has failed to help identify the magnitude of the problem. Many countries including the US and UK are increasingly relying on surveillance data to inform practice and policy. Hence, further studies are needed to explore or model the difference between actual and reported incidence of PCIs. Furthermore, a significant number of PCIs data collected by healthcare facilities are never reported to the next hierarchical level or published.[23] This presents a challenge to understanding the scope of the problem. Therefore, it is important to explore the reasons for under-reporting of sharps injuries at all levels and efforts made to address them.

This review has some limitations, therefore, our findings need to be interpreted with care. First, our review was limited by a lack of data from many countries as only data from 43 countries met the inclusion criteria. Also, our review included single or limited reports from some countries and many of the included reports were regional studies which were not nationally representative of the countries in which they were conducted. This could potentially impact on the generalisability of our findings. Secondly, our estimate of the one-year prevalence of PCIs largely depended on the intrinsic nature of the papers reviewed. Many of the included studies were conducted in hospital settings where the prevalence of sharps injuries is high. Hence our global one-year prevalence may have been overestimated. Thirdly, because the reviewed studies were based on self-reported retrospective data, they may be prone to recall and social

desirability biases. This may account for over-reporting among HCWs wishing to see preventive measures implemented in their setting, and under-reporting among those fearing to be blamed for not adhering to standard precautions. Finally, many factors influence the risk of transmission of blood-borne infections following PCIs including the type of device involved; whether hollow-bore needles or solid sharps. We were unable to present prevalence data split by these categories because of the lack of disaggregated data.

Despite these limitations, this review has increased awareness on the prevalence of PCIs among HCWs and should prompt relevant policies and actions across national governments, health systems and healthcare organisations. Since sharps' injuries are preventable, practical and implementable interventions like the use of safety-engineered devices; for instance, needleless intravenous system, auto-disabled syringes, and blunt sutures may bring about a significant reduction in the rates of occupational PCIs among HCWs. However, in many resource-limited settings, it may be more critical and cost-effective to address factors contributing to the increased risk of PCIs including behavioural contributors such as needle recapping, lack of training and increased workloads.[8] Whilst it is the responsibility of HCWs to adhere to standard precautions when handling sharps, national governments and employers have a responsibility to provide a safe working environment, educate all HCWs and establish policies that would minimise the risk of PCIs in healthcare settings.

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Conflicts of interests

The authors declare that they have no conflicts of interests.

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Tables

Table 1: Regional estimates of one-year prevalence of PCIs among HCWs

World Region	No. studies included	No. of Participants	One-year prevalence of PCI	Study heterogeneity
			% (95% CI)	I^2 (*P*-value)
Africa	**36**	**12958**	**34.5 (29.9 – 39.1)**	**97.0% (< 0.001)**
Sub-Saharan Africa	32	10663	32.5 (28.3 – 36.8)	95.9% (< 0.001)
North Africa	4	2295	49.7 (33.8 – 65.6)	98.3% (< 0.001)
Asia	**77**	**61966**	**43.2 (38.3 – 48.0)**	**99.4% (< 0.001)**
East	21	37188	47.2 (37.8 – 56.6)	99.7% (< 0.001)
South	25	8647	39.0 (30.4 – 47.6)	98.9% (< 0.001)
Middle East	31	16161	43.8 (35.5 – 52.1)	99.2% (< 0.001)
Australasia	**3**	**2609**	**9.5 (6.7 – 12.4)**	**80.4% (0.006)**
Europe	**18**	**16191**	**31.8 (25.0 – 38.5)**	**99.3% (< 0.001)**
Eastern Europe	5	2583	47.3 (27.4 – 67.1)	99.0% (< 0.001)
Northern Europe	5	5343	36.2 (11.3 – 61.1)	99.2% (< 0.001)
Southern Europe	4	2879	21.0 (10.8 – 31.2)	98.0% (< 0.001)
Western Europe	4	5386	18.9 (6.4 – 31.3)	99.4% (< 0.001)
North America	**12**	**14228**	**15.7 (12.1 – 19.3)**	**98.9% (<0.001)**
South America	**2**	**1315**	**7.7 (3.1 – 12.4)**	**80.7% (0.023)**
Global	**148**	**109267**	**36.4 (32.9 – 40.0)**	**99.6% (<0.001)**

Table 2: One-year prevalence of PCIs by job category of HCWs

World Region	Surgeons		Doctors		Nurses/midwives		Dental staff		Laboratory staff	
	n	prevalence % (95% CI)	n	Prevalence % (95% CI)	n	Prevalence % (95% CI)	n	Prevalence % (95% CI)	n	Prevalence % (95% CI)
Africa	0	ND	9	48.5 (28.5 – 68.5)	12	40.6 (26.8 – 54.5)	3	35.4 (30.8 – 40.1)	7	28.6 (13.3 – 43.9)
Asia	3	90.9 (86.2 – 95.6)	21	41.7 (33.5 – 49.9)	45	46.3 (40.4 – 52.1)	7	54.8 (43.6 – 66.0)	13	34.2 (19.0 – 49.3)
Australasia	0	ND	1	17.8 (12.7 – 22.9)	2	7.4 (6.3 – 8.4)	0	ND	0	ND
Europe	2	57.1 (24.9 – 89.3)	7	51.9 (34.2 – 69.6)	8	31.9 (22.9 – 40.9)	2	27.4 (0.5 – 55.4)	0	ND
North America	1	67.4 (60.7 – 74.1)	0	ND	3	7.8 (3.9 – 11.7)	1	6.0 (5.1 – 6.8)	0	ND
South America	0	ND	0	ND	0	ND	0	ND	0	ND
Overall	6	72.6 (58.0 – 87.2)	38	44.5 (37.5 – 51.5)	70	40.9 (35.2 – 46.7)	13	43.3 (28.2 – 58.4)	20	32.4 (20.9 – 43.9)

ND – not determined

Table 3: One-year prevalence of PCIs among HCWs based on institutional settings

World Region	Hospital settings		Non-hospital settings		Mixed settings	
	n	One-year prevalence % (95% CI)	n	One-year prevalence % (95% CI)	n	One-year prevalence % (95% CI)
Africa	23	36.5 (30.0 – 43.1)	0	ND	13	30.9 (25.6 – 36.2)
Asia	66	45.5 (40.3 – 50.7)	4	13.7 (11.3 – 16.0)	7	39.1 (23.2 – 55.1)
Australasia	2	12.3 (5.0 – 19.6)	0	ND	1	7.3 (5.6 – 8.8)
Europe	14	35.7 (26.1 – 45.2)	1	3.2 (1.4 – 5.0)	3	23.6 (11.9 – 35.2)
North America	1	64.7 (57.7 – 71.5)	8	5.9 (4.0 – 7.8)	3	28.3 (19.0 – 37.5)
South America	0	ND	2	7.7 (3.1 – 12.4)	0	ND
Overall	106	41.8 (37.6 – 46.0)	15	7.5 (5.9 – 9.1)	27	31.0 (25.8 – 36.1)

ND – not determined

Figures

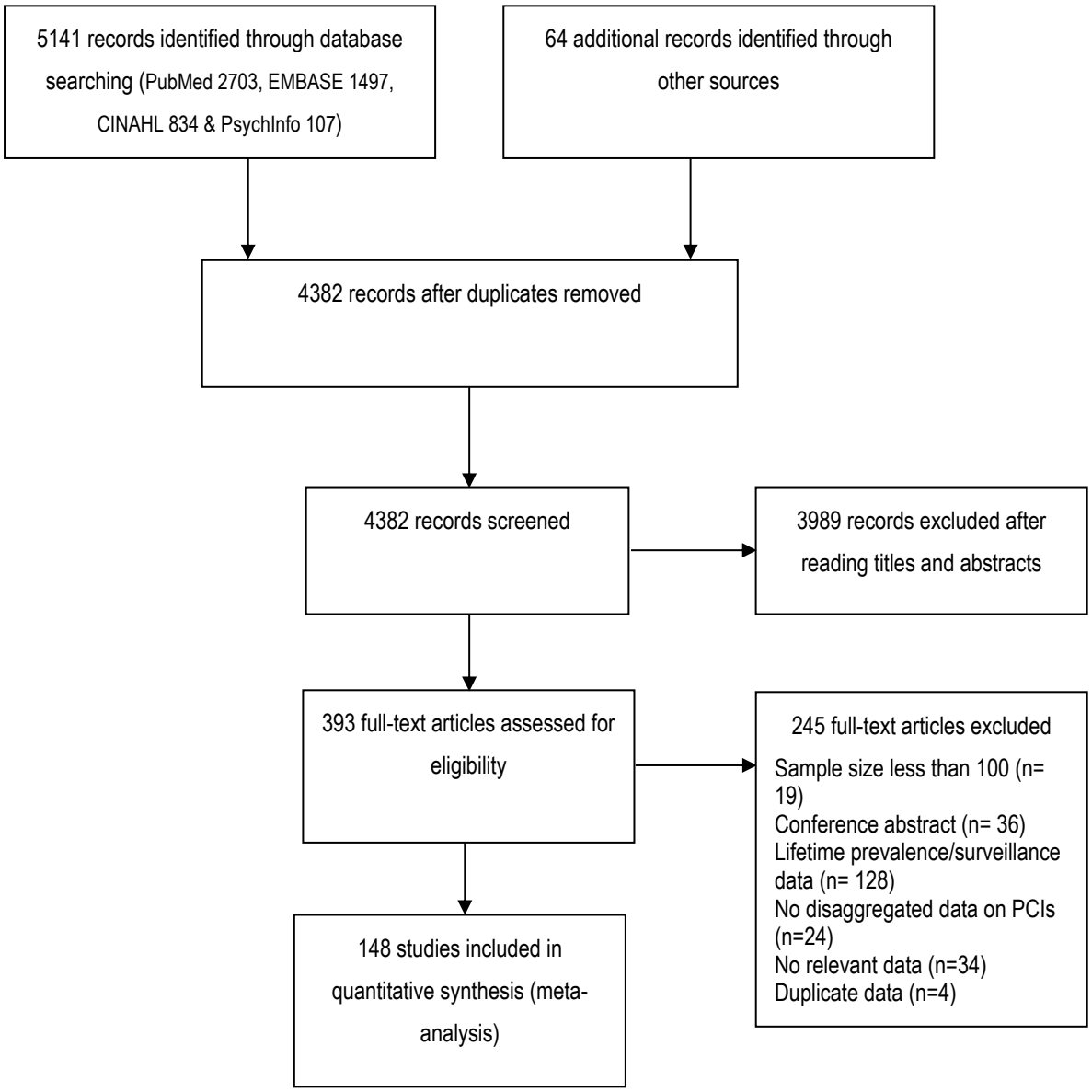


Figure 1: Flow diagram of article selection process

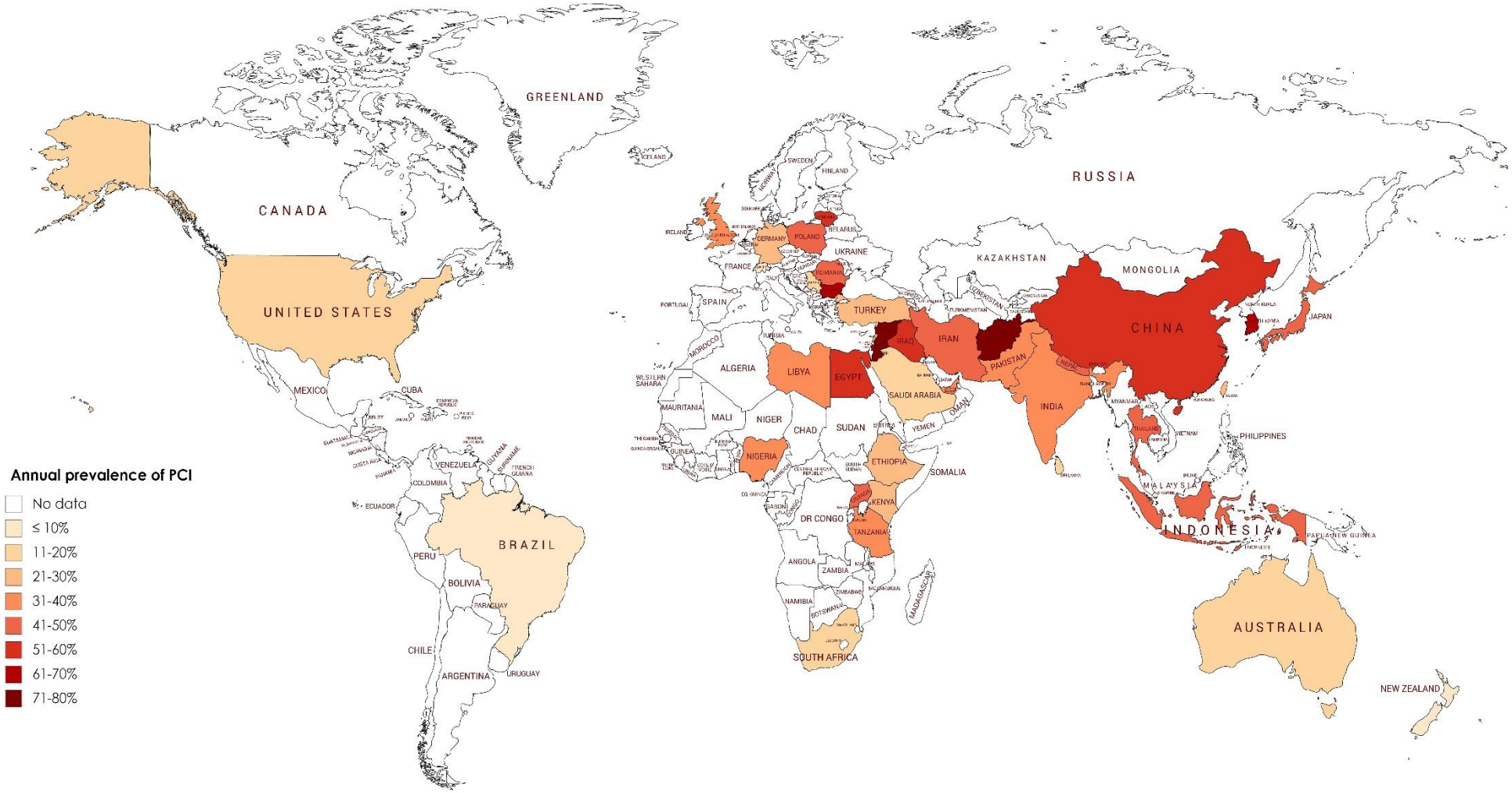


Figure 2: One-year prevalence of PCIs among HCWs by country

Supplementary Tables and Figures

Supplementary Table 1: Search strategy

#	Search strategy
1	Occupation* exposure OR Accident* exposure OR Occupation* disease OR Accidental blood disease* OR Accidental occupational exposure OR Occupational hazard* OR Occupational transmission OR Cross infection
2	Blood OR Body fluid* OR blood spill* OR needle injur* OR Blood borne pathogen* OR Sharps* OR Needle stick injur* OR Needle stick OR Blood-borne infection* OR percutaneous injur* OR cut* OR Human immunodeficiency virus OR HIV OR Hepatitis B OR Hepatitis C
3	Health care worker* OR Nurse* OR Midwive* OR Physician* OR Surgeon* OR Doctor* OR Health personnel OR Health worker* OR Dentist* OR Paramedic OR Health staff OR Medical personnel OR Health personnel OR Health officer*
4	1 AND 2 AND 3
5	Limit 4 to yr="2008–Current"

Supplementary Table 2: Criteria used for the methodological quality assessment

Criteria used for the methodological quality assessment
1. Was the sample frame appropriate to address the target population?
2. Were study participants sampled in an appropriate way?
3. Was the sample size adequate?
4. Were the study participants and the setting described in detail?
5. Was the data analysis conducted with sufficient coverage of the identified sample?
6. Were valid methods used for the identification of PCI?
7. Was the PCI measured in a standard, reliable way for all participants?
8. Was there appropriate statistical analysis?
9. Was the response rate ≥ 70%, and if not, was the low response rate managed appropriately?

All points were equally weighted

Supplementary Table 3: Characteristics of included studies

Study authors	Year of publication	Study country & region	Survey method used	Study participants & settings	One-year prevalence outcome by demography used in stratified analyses	Overall one-year PCI prevalence	Study quality
AFRICA							
Chalya et al [1]	2015	Tanzania, Africa	Interviewer-administered questionnaire	436 HCWs in Bugando Medical Centre, Mwanza	Nurses (38.8%), medical doctors (11.6%), lab staff (33.3%), male (33.3%), female (36.0%).	35.3%	Moderate
Bekele et al [2]	2015	Ethiopia, Africa	Self-administered questionnaire	340 HCW in four hospitals of Bale zone, Southeast Ethiopia	Nurses/midwives (21.9%), trained staff (10.2%), untrained staff (23.9%), male (19.6%), female (18.7%), ≤ 5years of experience (20.9%), > 5 years (16.3%)	19.1%	High
Beyera & Beyen [3]	2014	Ethiopia, Africa	Interviewer-administered questionnaire	401 HCWs in 4 public health institutions (1 hospital and 3 health centers) in Gondar city.		22.9%.	High
Mbaisi et al [4]	2013	Kenya, Africa	Interviewer-administered questionnaire	305 HCWs in Rift valley provincial general hospital.	Nurses/midwives (21.6%), medical doctors (13.8%), lab staff (25%), trained (14.2), untrained (24.7%), male (16.9%) & female (20.6%).	19%.	Moderate
Mashoto et al [5]	2013	Tanzania, Africa	Self-administered questionnaire	401 HCWs in Tumbi and Dodoma regional hospitals		39.1%.	Moderate
Mponela et al [6]	2015	Tanzania, Africa	Self-administered questionnaire	291 HCWs in one referral and two district hospitals in Mbeya region.	Nurses/midwives (24.8%), medical doctors (26.0%) & lab staff (11.1%),	22.0%.	Moderate
Kaweti & Abegaz [7]	2016	Ethiopia, Africa	Interviewer-administered questionnaire	496 HCWs in two public hospitals (Hawassa Referral and Adare District hospitals)		28.0%	High
Taegtmeyer et al [8]	2008	Kenya, Africa	Interviewer-administered questionnaire	554 HCW in 11 health facilities: two hospitals, eight health centres		30.0%.	Moderate

				and one dispensary in Thika District, .			
Reda et al [9]	2010	Ethiopia, Africa	Self-administered questionnaire	484 HCWs in 10 hospitals and 20 health centers in eastern Ethiopia.		31.0%.	Moderate
Tadesse & Tadesse [10]	2010	Ethiopia, Africa	Self-administered questionnaire	366 HCWs in 26 health facilities including a university teaching hospital and one private hospital in Awassa City, in southern Ethiopia		30.9%	High
Yenesew & Fekadu [11]	2014	Ethiopia, Africa	Self-administered questionnaire	317 HCWs in health care facilities in Bahir Dar town.		29.0%.	Moderate
Yimechew et al [12]	2013	Ethiopia, Africa	Self- and interviewer-administered questionnaire	285 HCWs in the University of Gondar Hospital.		32.5%.	High
Tesfay & Habtewold [13]	2014	Ethiopia, Africa	Interviewer-administered questionnaire	211 HCWs in two hospitals and two health centers in Debre Berhan town, Amhara region.		31.5%	Moderate
Shiferaw et al [14]	2012	Ethiopia, Africa	Self-administered questionnaire	126 medical waste handlers in three government hospitals in Addis Ababa.		42.1%.	Low
Kumakech et al [15]	2011	Uganda, Africa	Self-administered questionnaire	224 HCWs in Mbarara Regional Referral Hospital in south-western Uganda		23.6%.	Moderate
Zawilla & Ahmed [16]	2013	Egypt, Africa	Self-administered questionnaire	1036 HCWs in Cairo University Hospitals		40.0%	Moderate
Hanafi et al [17]	2011	Egypt, Africa	Self-administered questionnaire	645 doctors, nurses and auxillary staff in University of Alexandria teaching hospitals.	Nurses (73.6%), medical doctors (85.6%), lab staff (9.1%), male (32.6%), female (67.4%), ≤ 5years of experience (71.3%), > 5 years (51.3%)	67.9%	Moderate

Arheiam & Ingafou [18]	2015	Libya, Africa	Self-administered questionnaire	340 dental practitioners from different parts of Libya	Dental staff (35.1%), Male (37%), female (33.7%), ≤ 5years of experience (35.6%), > 5 years (35.2%)	35.1%	Moderate
Amira & Awobusuyi [19]	2014	Nigeria, Africa	Questionnaire survey	102 HCWs in four (two government and two private) dialysis units in Lagos, Nigeria.		24.5%.	Low
Osazuwa-Peters et al [20]	2013	Nigeria, Africa	Self-administered questionnaire	144 Medical and Dental house officers in 3 government hospitals in Edo State	Medical doctors (60.5%), Dentists (40.0%)	56.9%	Moderate
Owolabi et al [21]	2012	Nigeria, Africa	Self-administered questionnaire	230 HCWs in University of Abuja Teaching Hospital		24.8%.	Moderate
Sharew et al [22]	2017	Ethiopia, Africa	Self-administered questionnaire	195 HCWs in two hospitals in Debre Berhan town, Northeastern Ethiopia.		32.8%.	Moderate
Laisser & Ng'Home [23]	2017	Tanzania, Africa	Self-administered questionnaire	277 HCWs in 31 private and public health facilities Kahama District of north-western Tanzania		37.4%.	Moderate
Dilie et al.[24]	2017	Ethiopia, Africa	Self-administered questionnaire	193 HCWs in Awi Zone, Amhara Regional State, Northwest Ethiopia	Nurses/midwives (16.0%), Medical doctors (50.0%), Lab staff (16.7%),	18.7%	High
Ogoina et al.[25]	2014	Nigeria, Africa	Self-administered questionnaire	290 HCWs in two tertiary hospitals in Nigeria	Nurses/midwives (37.3%), medical doctors (42.1%), lab staff (37.5%), trained staff (47.3%), untrained staff (42.5%), male (44.4%), female (40.1%)	44.7%	Moderate
Olatosi and Anaegbu [26]	2016	Nigeria, Africa	Self-administered questionnaire	274 HCWs in three public tertiary hospitals and two private hospitals in Lagos	Nurses (78.6%), medical doctors (73.5%),	63.1%	Moderate
Reda et al. [27]	2009	Ethiopia, Africa	Self-administered questionnaire	330 HCWs in 19 health institutions in two regions of eastern Ethiopia		29.1%	Moderate

Ziraba et al.[28]	2010	Uganda, Africa	Self-administered questionnaire	370 HCWs in a tertiary hospital in Uganda	Nurses (72.4%), doctors (72.2%), Lab staff (72.2%), male (65.3%), female (68.8%)	67.8%	Moderate
Onadeko et al.[29]	2017	Nigeria, Africa	Self-administered questionnaire	977 HCWs in a tertiary hospital in Nigeria.		28.4%	Moderate
Aderaw [30]	2013	Ethiopia, Africa	Self-administered questionnaire	432 HCWs in East Gojjam Zone Health Institutions, Amahara Regional State	Male (27.5%), Female (15.1%)	22.2%	Moderate
Walle et al. [31]	2013	Ethiopia, Africa	Self-administered questionnaire	332 HCW in Felege Hiwot Referral Hospital, Bahir Dar, Northwest Ethiopia		31.0%	Moderate
Kruger et al. [32]	2012	South Africa, Africa	Self-administered questionnaire	202 nurses in a regional hospital in South Africa	Nurses (18.8%)	18.8%	Moderate
Diwe and Chineke [33]	2013	Nigeria, Africa	Interviewer-administered questionnaire	153 HCWs in Imo State University Teaching Hospital	Nurses/midwives 28.4%	23.5%	Moderate
Ahmed [34]	2014	Egypt, Africa	Self-administered questionnaire	236 Nurses at Zagazig University Hospitals, Sharkia Governorate, Egypt	Nurses (55.9%), male (43.2%), female (58.8%), ≤ 5years of experience (88.2%), > 5 years (42.9%)	55.9%	Moderate
Kebede et al. [35]	2012	Ethiopia, Africa	Interviewer-administered questionnaire	344 HCWs in two hospitals and three health centers in Gondar city	Trained staff (11.8%), untrained staff (37.8%), male (26.7%), female (35.7%), ≤ 5years of experience (27.3%), > 5 years (35.6%)	30.8%	Moderate
Tadesse et al. [36]	2016	Ethiopia, Africa	Self-administered questionnaire	623 HCWs in Wolaita Zone, Southern Ethiopia		55.1%	Moderate
ASIA							

Al-Ali and Hashim [37]	2012	United Arab Emirates	Self-administered questionnaire	733 dentists in three cities in the United Arab Emirates	Dentists (42.0%)	42.0%	Moderate
Askarian et al. [38]	2008	Iran	Self-administered questionnaire	1555 Nurses in hospitals of the Fars Province, Southern Iran	Nurses (50.0%), male (53.0%), female (48.0%)	50.0%	Moderate
Askarian et al. [39]	2012	Iran	Self-administered questionnaire	345 dental, nursing and midwifery students of Shiraz University of Medical Sciences, Iran	Students (73.0%)	73.0%	Low
Azadi et al. [40]	2011	Iran	Self-administered questionnaire	111 nurses working at five major teaching hospitals in Tehran	Nurses (34.2%)	34.2%	Moderate
Balouchi et al. [41]	2015	Iran	Self-administered questionnaire	200 nurses employed in two hospitals of Kerman.	Nurses (64.0%)	64.0%	Moderate
Chaudhari et al. [42]	2016	India	Self-administered questionnaire	100 post graduate residents at a tertiary care hospital	Doctors (56.0%)	56.0%	Moderate
Chen et al. [43]	2009	China	Interviewer-administered questionnaire	831 HCWs in nine hospitals in Fujian	Nurses (76.9%), Lab staff (40.2%),	71.3%	Moderate
Cheung et al. [44]	2012	Hong Kong	Self-administered questionnaire	878 Nursing students in a university in Hong Kong	Students (5.9%)	5.9%	Moderate
Cho et al. [45]	2013	South Korea	Self-administered questionnaire	3079 hospital nurses in South Korea	Nurses (70.4%)	70.4%	High
Fareed et al. [46]	2013	Pakistan	Self-administered questionnaire	100 students of the Nursing School, Sheikh Zayed Medical College/Hospital, Rahim Yar Khan	Students (44.0%)	44.0%	Low
Ghasemi et al. [47]	2017	Iran	Interviewer-administered questionnaire	267 nurses in Baqiyatallah Hospital, Tehran	Nurses (41.2%)	41.2%	Moderate

Gu et al. [48]	2013	China	Self-administered questionnaire	641 HCWs in an upper first class hospital in Naniing, China	Nurses (72.7%), doctors (46.9%), male (49.7%), female (60.9%), ≤ 5years of experience (61.8%), > 5 years (54.5%),	58.2%	Moderate
Hassnain et al. [49]	2017	Pakistan	Interviewer-administered questionnaire	386 nurses of two tertiary care hospitals of Lahore	Nurses (35.2%)	35.2%	Moderate
Honda et al. [50]	2011	Thailand	Self-administered questionnaire	250 Nurses in a Thai Regional Hospital	Nurses (55.5%)	55.5%	Moderate
Hosoglu et al. [51]	2009	Turkey	Self-administered questionnaire	5258 HCWs from 30 hospitals in 19 Turkish cities.	Nurses (50.1%), doctors (45.0%), lab staff (28.2%)	42.1%	Moderate
Hosoglu et al. [52]	2014	Iraq	Self-administered questionnaire	177 HCWs from seven hospitals/health centers in Erbil, northern Iraq.	Nurses (61.4%), doctors (55.9%), lab staff (37.0%)	55.9%	Moderate
Ismail et al. [53]	2014	Saudi Arabia	Interviewer-administered questionnaire	200 Primary Health Care workers in Jazan Region	Nurses (14.8%), doctors (12.0%)	14.0%	Moderate
Jacob et al. [54]	2010	United Arab Emirates	Self-administered questionnaire	994 HCWs in two private health care organizations in the UAE		19.0%	Moderate
Jahangiri et al. [55]	2016	Iran	Self-administered questionnaire	168 nurses in a university hospital, shiraz.	Nurses (51.2%)	51.2%	Moderate
Jeon et al. [56]	2015	South Korea	Self-administered questionnaire	253 dental hygienists in South Korea	Dental staff (59.3%), male (33.3%), female (40.4%), ≤ 5years of experience (77.3%), > 5 years (40.8%)	59.3%	Moderate
Joardar et al. [57]	2008	India	Self-administered questionnaire	228 nurses in two medical college hospitals of West Bengal	Nurses (61.4%)	61.4%	Moderate
Karthik et al. [58]	2015	India	Self-administered questionnaire	112 nursing students in a tertiary care hospital in Chennai	Students (33.5%)	33.5%	Low

Kasatpibal et al. [59]	2013	Thailand	Self-administered questionnaire	2031 operating room nurses in 247 hospitals in Thailand	Nurses (28.2%)	28.2%	Moderate
Kuruuzum et al. [60]	2008	Turkey	Self-administered questionnaire	350 HCWs in a university hospital, Izmir.		35.1%	Moderate
Lakbala et al. [61]	2014	Iran	Interviewer-administered questionnaire	215 operation room personnel in 14 hospitals of the Hormozgan province, Iran	Surgeon (85.2%)	89.3%	Moderate
Lo et al. [62]	2016	Taiwan	Self-administered questionnaire	19386 hospital nurses in Taiwan	Nurses (38.8%)	38.8%	High
Loerbroks et al. [63]	2015	China	Self-administered questionnaire	1791 female hospital nurses in China	Nurses (53.0%),	53.0%	Moderate
Mahfouz et al. [64]	2009	Saudi Arabia	Self-administered questionnaire	132 HCWs in primary health care centres	Nurses (16.5%), doctors (14.9%)	15.9%	Moderate
Mehrdad et al. [65]	2014	Iran	Self-administered questionnaire	339 nurses in a public hospital, Tehran	Nurses (54.6%), trained staff (63.5%), untrained staff (70.2)	54.6%	Moderate
Mohammadi et al. [66]	2011	Iran	Self-administered questionnaire	138 nurses working in Qazvin University of Medical Sciences, Qazvin	Nurses (52.9%)	52.9%	Moderate
Muralidhar et al. [67]	2010	India	Self-administered questionnaire	428 HCWs in a tertiary care hospital in New Delhi, India	Nurses (100%), doctors (82.1%), lab staff (84.3%)	80.1%	Moderate
Nagi et al. [68]	2017	Pakistan	Self-administered questionnaire	122 HCWs working in Shalamar Hospital, Lahore.		34.0%	Moderate
Nantsupawat et al. [69]	2015	Thailand	Self-administered questionnaire	1412 nurses in 92 community hospitals, Thailand	Nurses (48.3%)	48.3%	Moderate

Pavithran et al. [70]	2015	India	Interviewer-administered questionnaire	200 dental professionals in a dental college at Bangalore	Dental staff (27.5%)	27.5%	Moderate
Punia et al. [71]	2014	India	Self-administered questionnaire	162 HCWs in a tertiary care hospital in South India	Nurses (7.5%), doctors (22.0%)	17.2%	Moderate
Salehi and Garner [72]	2010	Afghanistan	Self-administered questionnaire	676 HCWs in hospitals in Kabul	Nurses (73.9%), doctors (62.0%), surgeons (91.9%), dental staff (75.4%), male (70.4%), female (73.8%)	72.6%	Moderate
Salelkar et al. [73]	2010	India	Interviewer-administered questionnaire	575 in a tertiary care hospital in India	Nurses (37.4%), doctors (45.2%), lab staff (16.7%), ≤ 5years of experience (36.4%), > 5 years (33.2%),	34.8%	Moderate
Shi et al. [74]	2011	China	Self-administered questionnaire	1201 HCWs in a general hospital		78.9%	Moderate
Shoghli et al. [75]	2013	Iran	Self-administered questionnaire	600 HCWs working in educational hospitals of Zanjan district		26.3%	Moderate
Smith et al. [76]	2009	Japan	Self-administered questionnaire	999 nurses in a Japanese teaching hospital	Nurses (42.0%)	42.0%	Moderate
Sobati and Reza [77]	2017	Iran	Self-administered questionnaire	283 nurses in Tehran Imam Khomeini Hospital Complex	Nurses (61.5%)	61.5%	Moderate
Sujatha et al. [78]	2017	India	Self-administered questionnaire	515 HCWs in a tertiary care hospital in Kerala.		35.0%	Moderate
Wang et al. [79]	2012	China	Self-administered questionnaire	458 nurses in a provincial teaching hospital	Nurses (63.7%)	63.7%	Moderate
Xu et al. [80]	2013	China	Self-administered questionnaire	205 HCWs in a Chinese dental hospital	Nurses (53.1%), dental staff (63.8%), students (41.7%)	52.7%	Moderate

Yacoub et al. [81]	2010	Syria	Interviewer-administered questionnaire	321 HCWs in three tertiary hospitals in Aleppo		76.6%	Moderate
Yilmaz et al. [82]	2016	Turkey	Self-administered questionnaire	163 emergence medical personnel	Paramedics (16.0%)	16.0%	Moderate
Yousafzai et al. [83]	2013	Pakistan	Self-administered questionnaire	317 private health practitioners in slum areas of Karachi, Pakistan	Male (29.2%), female (10.0%), ≤ 5years of experience (46.2%), > 5 years (22.1%),	26.7%	Moderate
Zhang et al. [84]	2015	China	Self-administered questionnaire	402 nurses at a teaching hospital in Nanjing	Nurses (64.9%), male (31.3%), female (66.3%), ≤ 5years of experience (71.1%), > 5 years (59.0%),	64.9%	Moderate
Zhang et al. [85]	2017	China	Self-administered questionnaire	393 nursing students from three universities in Nanjing	Trained HCWs (57.6%), untrained HCWs (78.4%), students (60.3%), male (19.7%), female (69.3%)	60.3%	Moderate
Zhang et al. [86]	2009	China	Self-administered questionnaire	1144 HCWs in a general hospital in China	Nurses (55.7%), doctors (41.3%), lab staff (30.3%)	50.3%	High
Sharma et al. [87]	2010	India	Self-administered questionnaire	190 in a tertiary care cardiac hospital	Nurses (10.0%), doctors (14.0%),	13.6%	Moderate
Wahsheh et al. [88]	2011	Jordan	Self-administered questionnaire	1068 HCWs working in public and private hospitals	Nurses (92.1%), doctors (85.5%), dental staff (100%), lab staff (89.0%)	86.4%	Moderate
Singru et al. [89]	2008	India	Interviewer-administered questionnaire	745 HCWs in a teaching hospital in Mumbai	Nurses (36.8%), doctors (25.9%)	30.2%	Moderate
Khader et al. [90]	2009	Jordan	Self-administered questionnaire	119 dentists in north Jordan	Dentists (66.5%)	66.5%	Moderate
Galougahi et al. [91]	2010	Iran	Self-administered questionnaire	158 nurses of Khanevadeh Hospital in Tehran	Nurses (22.2%)	22.2%	Moderate

Wu et al. [92]	2012	Taiwan	Self-administered questionnaire	329 emergency medical services personnel	Paramedics (11.9%)	11.9%	Moderate
Swetharani et al. [93]	2016	India	Self-administered questionnaire	401 HCWs in a tertiary care teaching hospital	Nurses (34.1%), doctors (67.5%), lab staff (10.0%)	43.0%	Moderate
Jaybhaye et al. [94]	2014	India	Interviewer-administered questionnaire	220 HCWs in a tertiary care hospital in rural India	Nurses (60.0%), doctors (40.0%), lab staff (20.0%)	49.1%	Moderate
Salmanzadeh et al. [95]	2016	Iran	Interviewer-administered questionnaire	377 HCWs in Dasht-e-Azadegan, Southern West of Iran	Nurses (39.5%), doctors (23.5%), male (8.5%), female (28.2%), ≤ 5years of experience (20.8%), > 5 years (15.4%)	18.3%	Moderate
Priyangani et al. [96]	2017	Sri Lanka	Self-administered questionnaire	401 nurses in district general hospitals of Sri Lanka	Nurses (15.2%)	15.2%	Moderate
Jain et al. [97]	2017	India	Interviewer-administered questionnaire	200 HCWs in a tertiary level hospital in Indore		32.0%	Moderate
Gharibi et al. [98]	2016	Iran	Self-administered questionnaire	211 medical students at Tabriz Imam Reza hospital	Students (36.0%)	36.0%	Moderate
Irmak [99]	2012	Turkey	Self-administered questionnaire	143 nurses at a state hospital in Turkey	Nurses (30.1%)	30.1%	Moderate
Gupta et al. [100]	2015	India	Self-administered questionnaire	312 HCWs in Rohilkhand Medical College and hospital, Bareilly	Nurses (67.3%), doctors (30.8%), lab staff (34.6%), students (69.2%)	52.6%	Moderate
Jan et al. [101]	2014	Pakistan	Interviewer-administered questionnaire	254 Dental personnel running private clinics at Hyderabad and Karachi.	Dental staff (53.1%)	53.1%	Moderate
Karawita et al. [102]	2012	Sri Lanka	Self-administered questionnaire	832 HCWs in six hospitals in Colombo district	Nurses (14.1%), doctors (23.1%), lab staff (9.9%)	9.5%	Moderate

Cui et al. [103]	2018	China	Self-administered questionnaire	901 HCWs in a provincial teaching hospital in China	Male (23.3%), female (28.9%), ≤ 5years of experience (34.4%), > 5 years (22.3%)	27.5%	Moderate
Al-Tell and Almurr [104]	2016	Palestine	Self-administered questionnaire	249 nurses in northern West Bank hospitals	Nurses (66.8%)	66.8%	Moderate
Bagdey et al. [105]	2014	India	Interviewer-administered questionnaire	450 nurses in a tertiary care hospital in Nagpur.	Nurses (31.8%)	31.8%	Moderate
Khoshnood et al. [106]	2015	Iran	Self-administered questionnaire	190 nursing and midwifery students of Kerman University of medical Sciences	Students (30.0%), male (40.0%), female (31.0%)	30.0%	Moderate
Paudel et al. [107]	2013	Nepal	Self-administered questionnaire	407 nursing students in Kathmandu	Students (46.9%)	46.9%	Moderate
Sabbah et al. [108]	2013	Lebanon	Self-administered questionnaire	277 HCWs in general hospitals in Lebanon		25.6%	Moderate
Sari et al. [109]	2011	Indonesia	Self-administered questionnaire	378 HCWs in the obstetrics and gynecology department of an Indonesian teaching hospital		48.0%	Moderate
Sayami and Tamrakar [110]	2013	Nepal	Self-administered questionnaire	314 HCWs in Tribhuvan University Teaching Hospital		40.8%	Moderate
Seng et al. [111]	2013	Singapore	Self-administered questionnaire	228 medical students of National University of Singapore	Students (3.5%)	3.5%	Moderate
Solmaz and Solmaz [112]	2017	Turkey	Self-administered questionnaire	550 HCWs in a State Hospital in Tokat Province	Nurses (24.6%), doctors (25.7%), lab staff (26.7%)	20.7%	Moderate
Yarahmadi et al. [113]	2014	Iran	Self-administered questionnaire	240 HCWs at a hospital in Tehran	Nurses (43%), doctors (53.3%), surgeon (80.0%), lab staff (13.3%), male (41.0%), female (40.1%), ≤ 5years of experience (43.2%), > 5 years (33.8%)	40.4%	Moderate

AUSTRALASIA							
Fullerton and Gibbons [114]	2011	New Zealand	Self-administered questionnaire	1346 HCWs within Waikato DHB	Nurses (7.5%), doctors (17.8%),	9.1%	Moderate
Guest et al. [115]	2014	Australia	Self-administered questionnaire	1110 HCWs in in public and private healthcare facilities in New South Wales, Australia	Nurses/midwives (7.3%)	7.3%	Moderate
Marjadi et al. [116]	2017	Australia	Self-administered questionnaire	153 medical students in an Australian university	Students (16.6%)	16.6%	Moderate
EUROPE							
Adams et al. [117]	2010	United Kingdom	Self-administered questionnaire	136 operating staff in a National Health Service trust in England	Surgeon (40.3%)	26.0%	Moderate
Cvejanov-Kezunovic et al. [118]	2014	Montenegro	Self-administered questionnaire	1043 HCWs in nine hospitals in Montenegro		31.4%	Moderate
Ganczak et al. [119]	2012	Poland	Self-administered questionnaire	503 HCWs in 16 hospitals in West Pomerania, Poland	Nurses (44.4%), doctors (82.0%)	50.7%	Moderate
Ganczak et al. [120]	2012	Poland	Self-administered questionnaire	110 gynecologic and obstetric staff in 15 hospitals in West Pomerania, Poland	Nurses (57.3%), doctors (76.2%)	60.9%	Moderate
Kerr et al. [121]	2009	United Kingdom	Self-administered questionnaire	164 Surgeons in three district general hospitals	Surgeons (73.2%)	73.2%	Moderate
Kevorkyan et al. [122]	2012	Bulgaria	Self-administered questionnaire	680 HCWs in at St George University Hospital, Plovdiv	Nurses (62.0%), doctors (63.4%)	62.0%	Moderate

Markovic-Denic et al. [123]	2013	Serbia	Self-administered questionnaire	216 HCWs in three university hospitals in Belgrade		25.9%	Moderate
Markovic-Denic et al. [124]	2014	Serbia	Self-administered questionnaire	983 HCWs in five tertiary care hospitals and in one secondary care hospital in Belgrade	Nurses (18.0%), doctors (21.8%),	17.8%	Moderate
Rybacki et al. [125]	2013	Poland	Self-administered questionnaire	1138 Polish HCWs		21.3%	Moderate
Voide et al. [126]	2012	Switzerland	Self-administered questionnaire	2691 HCWs in a Swiss University Hospital	Nurses (8.6%), doctors (18.9%)	9.7%	Moderate
Wicker et al. [127]	2010	Germany	Self-administered questionnaire	377 emergency medical services personnel	Paramedics (3.2%)	3.2%	Moderate
Wicker et al. [128]	2008	Germany	Self-administered questionnaire	720 HCWs in a German university hospital	Nurses (22.0%), doctors (55.1%)	31.4%	Moderate
Wicker et al. [129]	2008	Germany	Self-administered questionnaire	1598 HCWs in Frankfurt university hospital	Doctors (49.9%)	31.5%	High
Barlean et al. [130]	2013	Romania	Self-administered questionnaire	152 Dentists in Moldavian region of Romania	Dentists (41.8%)	41.8%	Low
RCN, UK [131]	2008	United Kingdom	Self-administered questionnaire	4727 nurses in the United Kingdom	Nurses (10.0%)	10.0%	Moderate
Marusic et al. [132]	2017	Serbia	Self-administered questionnaire	637 medical students in the University of Belgrade	Students (9.4%)	9.4%	High
Lukianskyte et al. [133]	2011	Lithuania	Self-administered questionnaire	196 nurses and nursing students at the Republic Hospital of Kaunas	Nurses (38.5%), students (78.0%)	58.7%	Moderate

Winchester et al. [134]	2012	United Kingdom	Self-administered questionnaire	120 HCWs at the Dental Institute, Kings college hospital NHS foundation trust	Dental staff (13.3%)	13.3	Moderate
NORTH AMERICA							
Brouillette et al. [135]	2017	United States	Self-administered questionnaire	1178 home care aides in the United States	Male (10.8%), female (3.2%)	2.0%	High
Cleveland et al. [136]	2012	United States	Self-administered questionnaire	3042 US dentists	Dentists (6.0%)	6.0%	Moderate
Leiss [137]	2010	United States	Self-administered questionnaire	2664 US paramedics	Paramedics (6.7%)	6.7%	Moderate
Lipscomb et al. [138]	2009	United States	Self-administered questionnaire	1774 Home Care Workers and Home Care Registered Nurses in the US	Nurses (8.9%)	5.5%	Moderate
LoPiccolo et al. [139]	2012	United States	Self-administered questionnaire	188 Surgeons in the US	Surgeons (64.7%)	64.7%	Moderate
Quinn et al. [140]	2009	United States	Self-administered questionnaire	1225 home care nurses and aides in the United States	Nurses (4.3%)	3.4%	High
Quinn et al. [141]	2016	United States	Self-administered questionnaire	1249 home car aides in the US		1.8%	High
Reddy et al. [142]	2009	United States	Self-administered questionnaire	1061 Interventional radiologists in the United States		25.4%	Moderate
Deipolyi et al. [143]	2017	United States	Self-administered questionnaire	908 Interventional radiologists in the United States		19.7%	Moderate

Donnely et al. [144]	2013	United States	Self-administered questionnaire	336 US dermatology residents, fellows, and practicing dermatologists		40.6%	Moderate
Alhazmi et al. [145]	2017	United States	Self-administered questionnaire	248 Emergency Medical Services personnel	Paramedics (18.2%)	18.2%	Moderate
Scarf et al. [146]	2009	United States	Self-administered questionnaire	355 home health care nurses	Nurses (10.7%)	10.7%	Moderate
SOUTH AMERICA							
Garcia and Fachini [147]	2009	Brazil	Interviewer-administered questionnaire	1077 HCWs in Brazilian primary health care		5.7%	High
Oliveira et al. [148]	2009	Brazil	Self-administered questionnaire	228 Emergency Medical Services personnel	Paramedics (10.5%)	10.5%	Moderate

Supplementary Table 4: Estimated one-year prevalence of PCIs by country

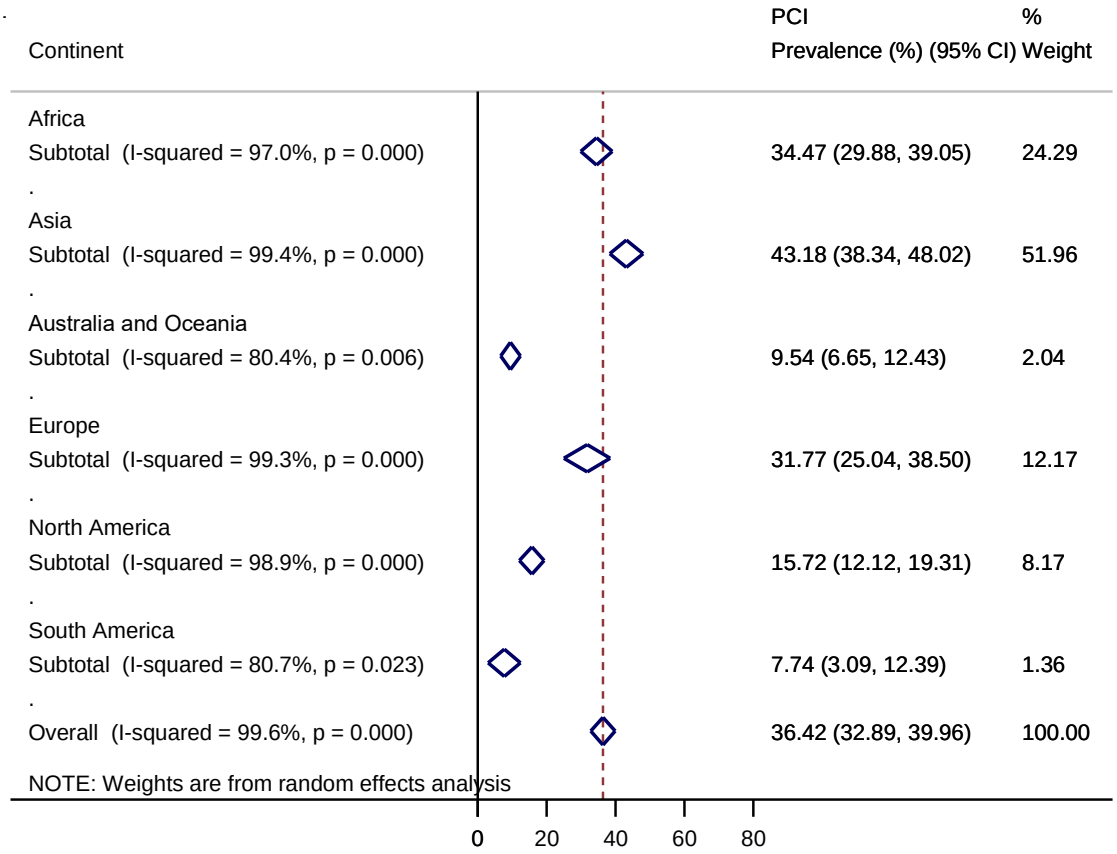
Countries	No. studies included	No. of Participants	Prevalence of PCI
			% (95% CI)
Africa	**36**	**12958**	**34.4 (29.8 – 38.9)**
Egypt	3	1917	54.6 (35.3 – 73.8)
Ethiopia	16	5433	30.3 (25.5 – 35.1)
Kenya	2	859	24.6 (13.8 – 35.3)
Libya	1	378	35.1 (30.3 – 39.9)
Nigeria	7	2170	38.0 (26.4 – 49.5)
South Africa	1	202	18.8 (13.4 – 24.2)
Tanzania	4	1405	32.8 (25.3 – 40.2)
Uganda	2	594	45.7 (2.4 – 89.0)
Asia	**77**	**61966**	**43.8 (38.5 – 49.1)**
Afghanistan	1	676	72.6 (69.2 – 76.0)
China	10	7967	58.1 (47.8 – 68.4)
Hong Kong	1	878	5.9 (4.3 – 7.5)
India	15	4838	39.8 (30.2 – 49.5)
Indonesia	1	376	48.0 (43.0 – 53.1)
Iraq	1	177	55.9 (48.6 – 63.2)
Iran	16	5397	46.6 (36.2 – 57.0)
Japan	1	999	42.0 (38.9 – 45.1)
Jordan	2	1187	76.9 (57.4 – 96.4)
Lebanon	1	277	25.6 (20.5 – 30.7)
Nepal	2	721	44.0 (38.0 – 50.0)
Pakistan	5	1179	38.4 (28.8 – 48.0)
Palestine	1	249	66.8 (61.0 – 72.6)
Saudi Arabia	2	332	14.7 (10.9 – 18.5)
Singapore	1	228	3.5 (1.1 – 5.9)
South Korea	2	3332	65.2 (54.4 – 76.1)
Sri Lanka	2	1233	12.2 (6.6 – 17.7)
Syria	1	321	76.6 (72.0 – 81.2)
Taiwan	2	19715	25.4 (-1.0 – 51.8)
Thailand	3	3693	43.8 (27.3 – 60.4)
Turkey	5	6464	28.9 (17.1 – 40.6)
United Arab Emirates	2	1727	30.5 (7.9 – 53.0)
Australasia	**3**	**2609**	**9.5 (6.7 – 12.4)**
Australia	2	1263	11.5 (2.4 – 20.6)
New Zealand	1	1346	9.1 (7.6 – 10.6)
Europe	**18**	**16191**	**31.8 (25.0 – 38.5)**
Bulgaria	1	680	62.0 (58.4 – 65.6)
Germany	3	2695	22.0 (1.3 – 42.8)
Lithuania	1	196	58.7 (51.8 – 65.5)
Montenegro	1	1043	31.4 (28.6 – 34.2)
Poland	3	1751	44.1 (19.3 – 68.8)
Romania	1	152	41.8 (34.0 – 49.6)
Serbia	3	1836	17.3 (9.4 – 25.2)
Switzerland	1	2691	9.7 (8.6 – 10.8)
United Kingdom	4	5147	30.5 (4.7 – 56.3)
North America	**12**	**14228**	**15.7 (12.1 – 19.3)**
United States	12	14228	15.7 (12.1 – 19.3)
South America	**2**	**1315**	**7.7 (3.1 – 12.4)**
Brazil	2	1315	7.7 (3.1 – 12.4)
Global	**148**	**109267**	**36.4 (32.9 – 40.0)**

Supplementary Table 5: One-year prevalence of PCIs among HCW by income level of countries

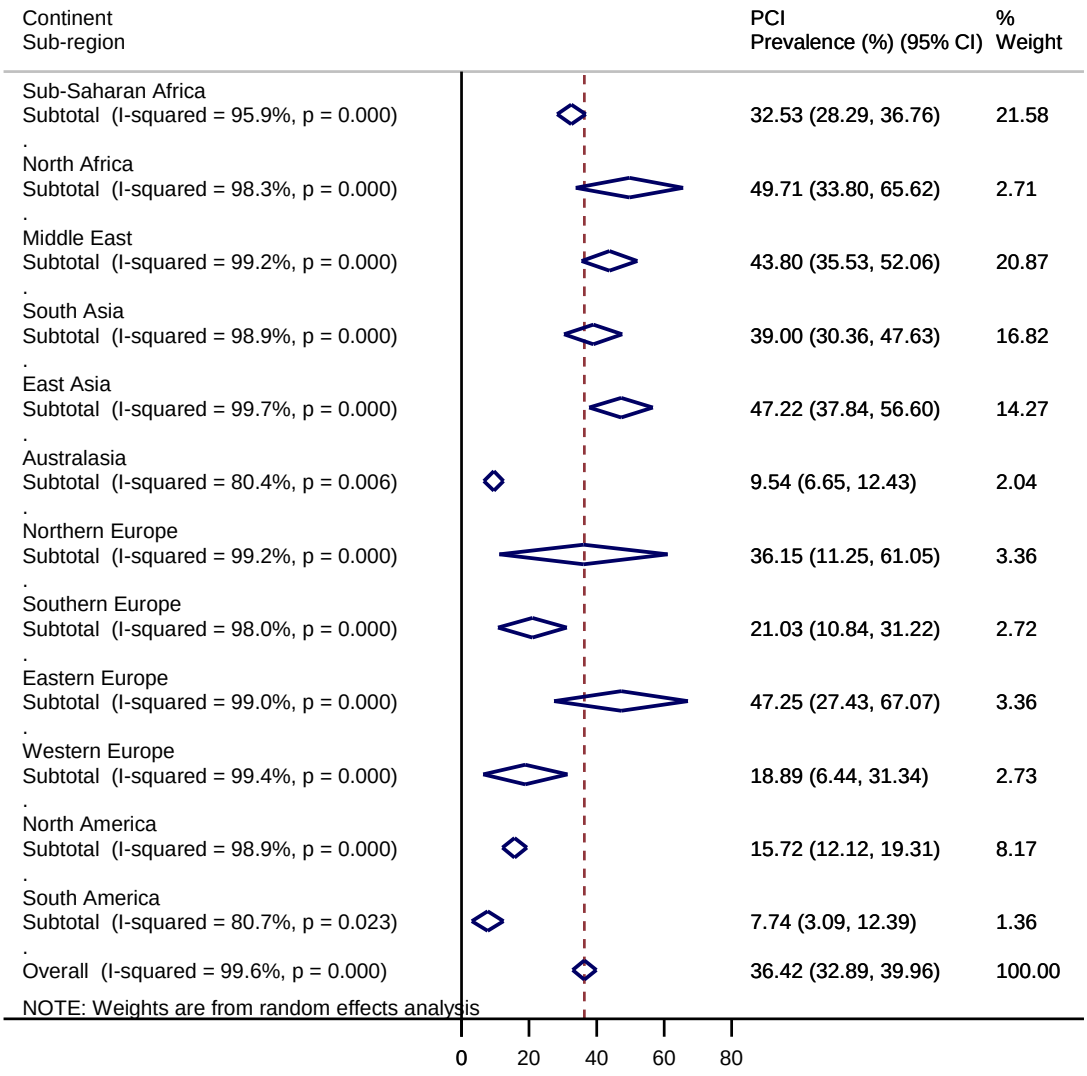
World Region	High income Countries		Middle income countries		Low income countries	
	N	One-year prevalence % (95% CI)	N	One-year prevalence % (95% CI)	N	One-year prevalence % (95% CI)
Africa	0	ND	13	38.3 (29.0 – 47.5)	23	32.2 (27.4 – 37.0)
Asia	11	29.3 (15.9 – 42.8)	61	44.7 (39.2 – 50.3)	5	55.1 (41.8 – 68.3)
Australasia	3	9.5 (6.6 – 12.4)	0	ND	0	ND
Europe	12	32.0 (24.4 – 39.5)	6	31.3 (16.1 – 46.5)	0	ND
North America	12	15.7 (12.1 – 19.3)	0	ND	0	ND
South America	0	ND	2	7.7 (3.1 – 12.4)	0	ND
Overall	**38**	**24.8 (19.4 – 30.2)**	**82**	**41.8 (36.7 – 46.9)**	**28**	**36.3 (30.3 – 42.2)**

ND – not determined

Supplementary Figures



Supplementary Figure 1: Continent estimates of one-year prevalence of PCIs among HCWs



Supplementary Figure 2: Sub-continent estimates of one-year prevalence of PCIs among HCWs

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